

THE RELATION OF THE FOOD TO THE SIZE AND
SHAPE OF THE BILL IN THE GALAPAGOS
GENUS *GEOSPIZA*.

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THE Fringillid genus *Geospiza*¹ of the Galapagos Archipelago contains about thirty-four species and varieties. Four subgenera may be distinguished on a color basis, but the specific and varietal character are almost entirely in the shape and size of the bill. The bill being the feeding organ, it is most natural to look first for the cause of its variation in a variation of the character of the food.

Geospiza heliobates feeds entirely on insects. But it inhabits exclusively the 'mangrove swamps' where there is nothing but insect food available. The other species are all seed-eaters, although they occasionally pick up a few ants and other small insects. The seeds that they eat are mostly small and they are usually swallowed whole, being found in this condition in the crop. Large seeds when eaten are broken into pieces by the beak before being swallowed, generally only fragments of such are to be found in the stomach. The birds feed a great deal upon the ground, picking up seeds that have fallen from the bushes, and at the same time taking in with the food a considerable amount of gravel.

With a view of determining whether there is any corresponding variation between the bills and the food, Mr. Edmund Heller and the writer, during 1898 and 1899, preserved the stomachs of two hundred and nine specimens of *Geospiza*. These represent *G. pachyrhyncha*, *G. strenua*, *G. conirostris*, *G. fortis fortis*, *G. fortis platyrhyncha*, *G. fuliginosa*, *G. scandens*, *G. scandens fatigata*, *G.*

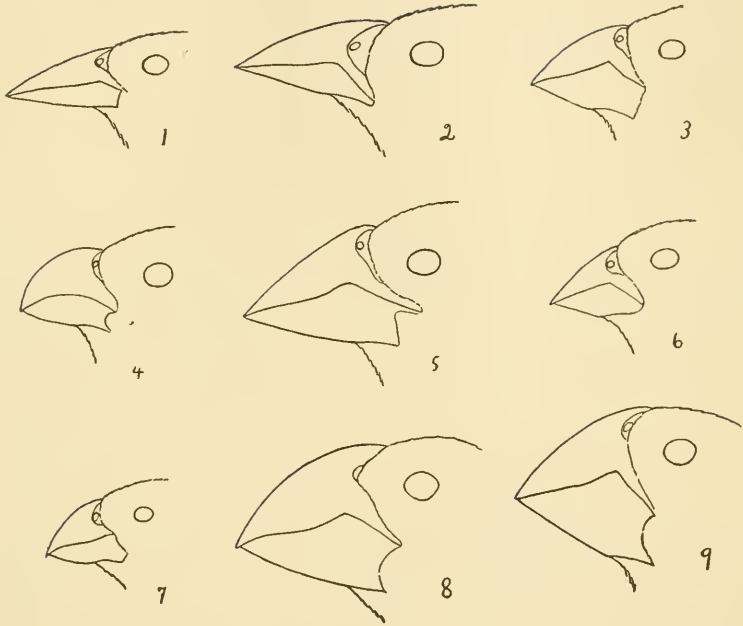
¹The name *Geospiza* is here used in the same sense as used by Rothschild and Hartert (Novit. Zool., VI, 1899), *i. e.*, to include all of the related Galapagos genera of other authors, such as *Platyspiza*, *Camarhynchus*, *Geospiza* and *Cactornis*. Such a group is certainly a natural one; and in it lines of division are difficult to draw. Ridgway recognizes three genera: *Platyspiza*, *Camarhynchus* and *Geospiza*. The names of species are according to the synonymy in a paper yet to be published by Mr. Edmund Heller and the writer.

scandens rothschildi, *G. affinis*, *G. crassirostris*, *G. prothemelas*, *G. heliobates*. The specimens were collected from the islands of Albemarle, Narborough, James, Seymour, Duncan, Charles, Hood, Barrington, Tower and Bindloe. The dates run from December till June, inclusive.

Comparison has been made of the food of individuals of the same species at different places, and of the food of different species at the same and at different places. The results are somewhat conflicting. In any case one would require a great amount of evidence to come to any definite conclusions. Then, too, there is always a doubt created by the fact that the specimens were not taken on the different islands during the same months, and by the fact that the seasons vary considerably at different localities. What might appear to be evidence of a difference in food habit between a species on one island and a different one on another island, might be nothing more than a seasonal change of diet due to different plants being in seed at the two times. However, a few conclusions may be positively deduced, the results being sufficient to warrant the discussion.

The detailed records of the two hundred and nine stomachs are omitted. The data obtained are given in the following table, and the seeds are illustrated on Plates XII and XIII. The seeds have not been identified, but the names are not necessary. They are drawn to show their relative sizes, and are referred to in the succeeding discussion by their numbers on the plates. Figures 1 to 44, inclusive, except figure 42, are magnified $6\frac{2}{3}$ times. The others are magnified only half as much. The stomachs of Mockingbirds (*Nesomimus*) from eight islands have been examined in the same way. The records of these are given at the end of the table, and the seeds are figured on the plates along with the *Geospiza* seeds. The stomachs of all contained a total of sixty kinds of seeds. Seeds Nos. 59 and 60 are not figured.

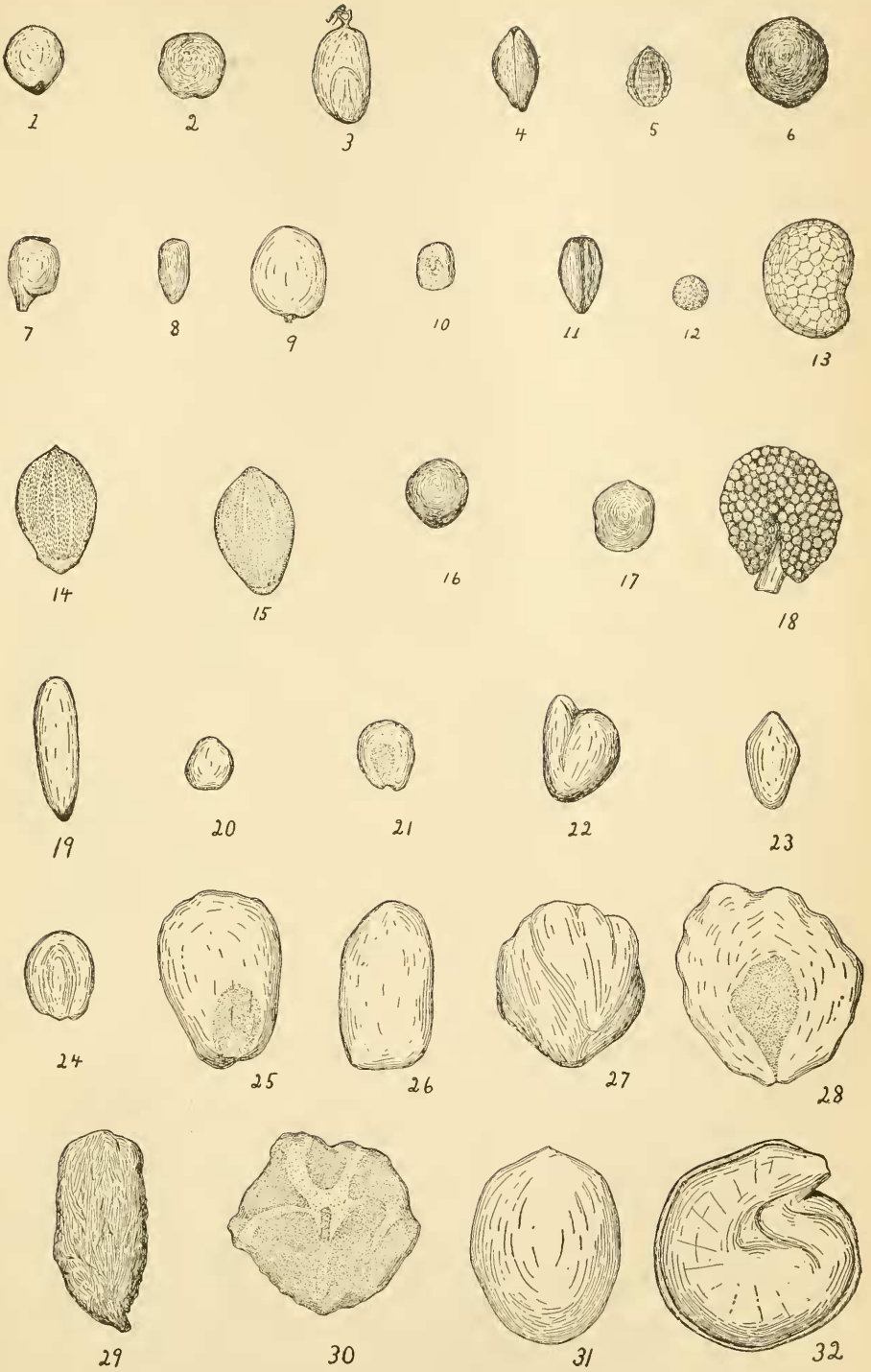
Following is the table (pp. 369-374) containing the records of the examination. It of course does not show the relative numbers of each seed present.



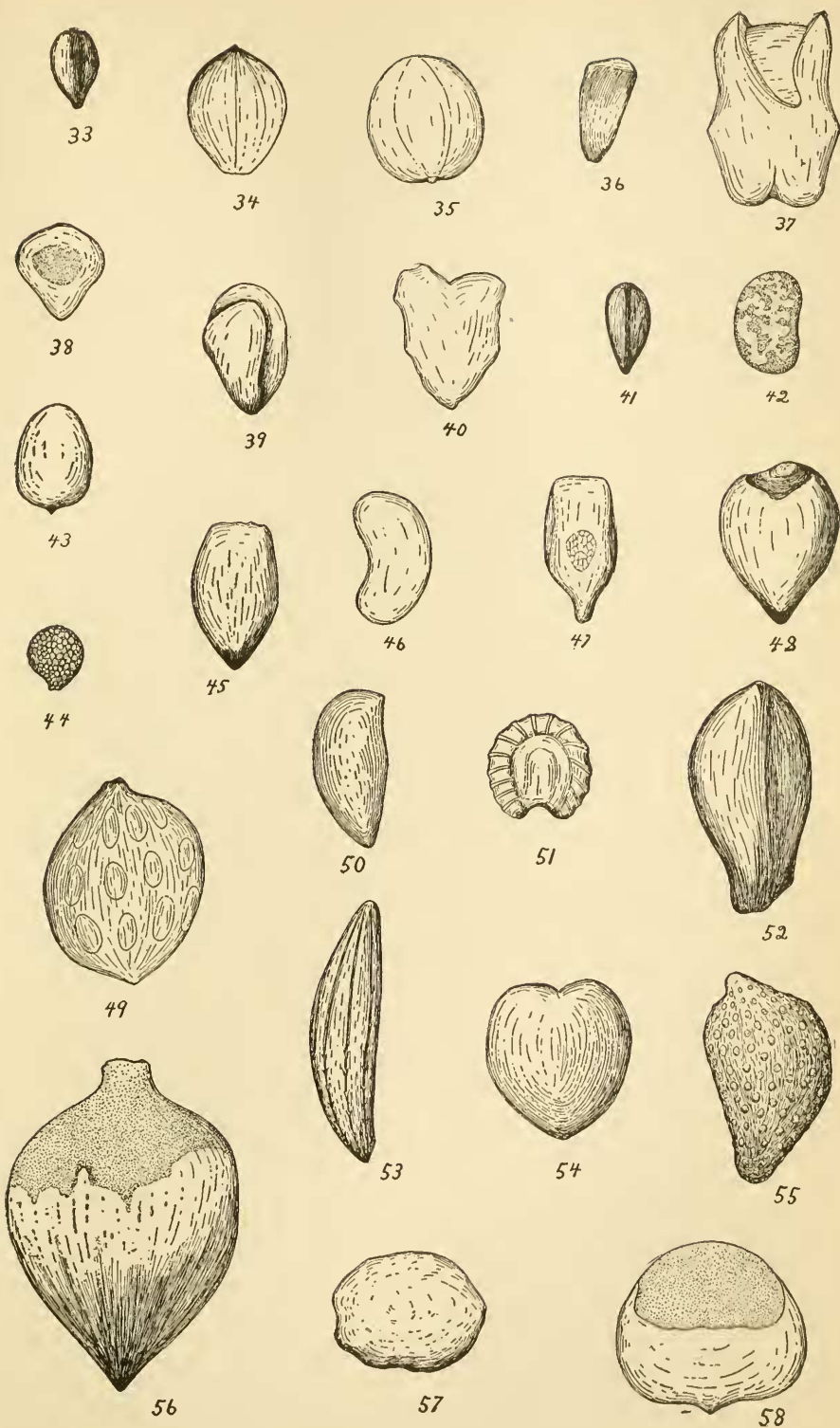
BILLS OF GEOSPIZA.

Natural Size.

- Fig. 1. *Geospiza scandens scandens*, James Island, from Ridgway.
- Fig. 2. *G. scandens rothschildi*, Bindloe Island.
- Fig. 3. *G. fortis fortis*, Albemarle Island, from Ridgway.
- Fig. 4. *G. crassirostris*, from Ridgway after Gould.
- Fig. 5. *G. conirostris conirostris*, Hood Island, from Ridgway.
- Fig. 6. *G. fuliginosa parvula*, Tagus Cove, Albemarle Island.
- Fig. 7. *G. prothemelas prothemelas*, Albemarle Island.
- Fig. 8. *G. streuua*, Albemarle Island, from Rothschild.
- Fig. 9. *G. pachyrhyncha*, Tower Island, from Ridgway.



FOOD SEEDS OF GALAPAGOS BIRDS.



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From the facts given in the table the following propositions may be pretty well established.

I. *The food of GEOSPIZA as a whole differs from that of NESOMIMUS.*

This is evident from the fact that of the twenty-one seeds found in the *Nesomimus* stomachs, only eight were found in *Geospiza* stomachs. Of these seed No. 8, which was the predominant seed in the food of *Geospiza fuliginosa parvula* at Tagus Cove, Albemarle, was found in two specimens of *Nesomimus* from Bindloe Island. Seed No. 18, which occurred in eight *Nesomimus* stomachs, was present in only three *Geospiza* stomachs. The other seeds common to the diets of the two genera were of rare occurrence in each.

Nesomimus eats a great many more insects than does *Geospiza*, being insectivorous and granivorous in about equal proportions. Numerous pieces of large insects were found in nearly all of the *Nesomimus* stomachs, including grasshoppers, flies, beetles, caterpillars, and also spiders and centipedes. The seed part of the diet differs from the food of *Geospiza* in consisting of larger seeds, of seeds that the much smaller-mouthed *Geospiza* could not handle.

II. *The same species at different localities may feed on different seeds.*

The truth of this statement is best shown by a study of the food of *Geospiza fuliginosa parvula* (Pl. XI, Fig. 6) the most widely spread and most abundant form of *Geospiza* on the archipelago. In the stomachs of nineteen specimens of this variety from Tagus Cove, Albemarle Island, collected in January, there was found a total of only eleven species of seeds. Of these, seed No. 1 had been eaten by two birds, No. 2 by one bird, No. 4 by two birds, No. 6 by two birds, No. 8 by nine birds, No. 15 by one bird, No. 22 by five birds, No. 24 by three birds, No. 41 by two birds, No. 58 by one bird, and No. 59 by one bird. This shows that the birds here feed on seed No. 8 more than any other, and that seed No. 22 was second in numbers. Moreover, these two seeds were present in much greater numbers than the others in each stomach in which they occurred.

From Elizabeth Bay, Albemarle, there are only two specimens